

The Temporal Causality Between Investment And Growth In Developing Economies

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Abstract

This paper addresses the ongoing debate regarding the temporal causality between economic growth and investment. It examines the link between long-term economic growth and investment in 80 developing economies for the average period 1982-97 by employing the New Growth model in a Simultaneous Equation approach. Findings reveal a strong positive one-way relationship between investment and subsequent growth. This result supports the argument that investment is instrumental and precedes growth rather than the reverse. Unlike the mainstream view regarding the "direct" trade-growth nexus, results show that trade openness becomes insignificant once investment enters the model. Additionally, trade openness is found to positively and significantly affecting investment, and hence fostering growth via the investment variable. Finally, risk is negatively associated with investment indicating that perhaps investors are less attracted to risky markets in developing economies.

1. Introduction

This paper examines the temporal causality between long-term economic growth and investment in 80 developing economies by employing the New Growth model in a Simultaneous Equation approach. In the last decade, research interest on economic growth has been revived and resulted in a number of studies that deal with the issue of economic growth and investment. However, these growth studies (e.g., Sala-i-Martin, 1997; Doppelhofer et al., 2000; Barro, 1997; DeLong and Summers, 1991; and Mankiw, Romer, and Weil, 1992) focused primarily on either estimating the determinants of long-term economic growth or examining the international environment for business activities.

Despite the large number of growth empirical studies, there is no consensus on the causal relationship between investment and growth. This is perhaps due to the purpose of the research, the growth models used (whether neoclassical or endogenous), the design of the sample, and/or the methodology adopted.

The controversy on the link between growth and investment is evident in many recent studies, and there has not been sufficient empirical work on the specific nature of the relation between growth and investment. The bulk of recent work estimates determinants of growth and their robustness by using different econometric techniques (Bayesian Averaging of Classical Estimates, Extreme Bounds method, and Seemingly Unrelated Regressions).

Recent comprehensive empirical studies pertinent to the determinants of growth (Sala-i-Martin, 1997; Doppelhofer et al., 2000) include all potential variables in different regression combinations. These studies exclude investment from their models or estimate the models with and without investment to observe any changes in results. However, these studies do not use the same "trial" approach (used with investment) with any of the other 62 tested variables. This implies the uncertainty of the "exact" role of investment in growth regressions, yet its integral part of the growth framework.

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Previous studies have found that investment significantly stimulates growth, while others found that economic growth spurs investment. Even a number of scholars (Barro and Sala-i-Martin, 1995 and Kenny and Williams, 1999) reported a statistically insignificant link between growth and investment. Consequently, this study focuses on the causal relationship between growth and investment rather than the usual quest for the determinants of growth. It adopts the New Growth model as developed by Barro (1995; 1997). The system of equations allows for the detection of potential endogenous variables and highlights their instrumentality. This study identifies the “real” driving force for long-term growth, as well as the essential factors that investors should review in targeting potential markets.

The rest of this paper is organized as follows: Section II reviews models of economic growth. Section III summarizes the role of investment. Section IV discusses the methodology and the simultaneous equation system. Section V analyzes the econometric findings. Conclusions, policy implications, and future research are offered in section VI.

2. Growth Models

Neoclassical growth models (Solow, 1956; and Swan, 1956) are recognized by their convexity feature (convex shaped-curve). This is derived from the assumption of diminishing returns to capital, which implies that the growth rate is a function of capital investment. However, growth convexity is contradicted by the historical evidence (e.g., U.S. long-term growth in the last few centuries.) The major contribution of Solow and Swan neoclassical models is the convergence property; i.e. poorer countries tend to grow faster than richer ones.

Romer (1986), Lucas (1988), and Rebelo (1991) constructed the first endogenous growth models where human capital is endogenous and the growth rate may continue to increase. This comes from the assumption that returns on investment in this broader capital element do not necessarily exhibit diminishing marginal returns. This non-convexity feature provided endogenous models with an advantage over their neoclassical counterparts. Although endogenous theories restored the neoclassical problem of convexity through the endogenous role of human capital, they were unable to predict the conditional convergence property. This property is strongly supported by empirical evidence in many settings. Obviously, the growth rate is no longer a negative function of capital investment.

Both neoclassical and endogenous models have major shortcomings in predicting continuous long-run growth in the former, and convergence in the latter. The contributions of Mankiw, Romer, and Weil (1992) and Barro and Sala-i-Martin (1995) in developing the new growth models were to address the downfall in each model. The culmination of these efforts was the new growth theory, which models technological diffusion (Barro and Sala-i-Martin, 1997). The new growth theory combines the long-run growth of endogenous models (from the discovery of ideas in the rich developed economies) with the convergence property of the neoclassical growth theories (from the gradual imitation by followers).

3. Investment

Investment is defined by the International Monetary Fund (IMF) as the summation of gross fixed capital formation and increase (decrease) in stocks. In the neoclassical growth model for a closed economy, the saving rate is exogenous and equal to the ratio of investment to output. A higher saving rate raises the long-run level of output per worker and thereby increases the growth rate, holding the initial level of GDP constant. Several empirical studies, DeLong and Summers (1991) and Mankiw, Romer, and Weil (1992), examined the effects of total investment (public plus private) on growth across countries. They found a statistically significant and positive role of investment as measured by the ratio of real gross domestic investment (GDI) to real gross domestic product (GDP). Similarly, Kormendi and Meguire (1985) and Levine and Renelt (1992) reported that the investment share of GDP has a significant and positive effect on growth.

Still the direction of the causal relationship between investment and growth was not addressed. In fact, a number of studies argue in favor of the growth-investment direction or the insignificant role of investment. For in-

stance, Blomstrom, Lipsey, and Zejan (1993) reported a one-way relation between investment and growth where the former has a positive impact on the latter. Barro and Sala-i-Martin (1995) and Barro (1997) found that when underlying variables like life expectancy, are accounted for the direct effect of investment on growth loses its explanatory power. They imply a probable causation from growth to investment.

Barro (1997) also argue that the growth on investment causality might especially apply for an open economy. In this context, he tested this relation by regressing the traditional determinants of growth (e.g., income, life expectancy, fertility, and so on) on the investment ratio and found that a number of variables that affects growth also appear as stimulants to investment. His interpretation of the results is that some policy variables enhance economic growth partly by encouraging investment.

Chen and Feng (2000) examined the determinants of economic growth across China provinces, and found that investment has an insignificant impact on growth. Kenny and Williams (1999) reported that investment alone can not account for variation in growth. Other researchers such as Barro and Sala-i-Martin (1995) have suggested that measures of investment are problematic since they include both private and public expenditures. Those researchers linked this measurement problem to studies where investment failed to have a significant positive impact on growth. Some attempts have been made to separate the total investment into public and private investment and examine their impact on growth (Barro and Sala-i-Martin, 1995); however, results do not differ significantly from using the aggregate investment variable.

Sala-i-Martin (1997) collected 63 variables (including investment) from the growth literature, and tested these variables in sets of three, first without the investment rate appearing in any of the regressions and then with the investment rate as a fixed variable. He found that public investment is negatively related to growth while private investment is insignificant and non-robust according to the Extreme Bounds method.

Doppelhofer et al. (2000) assessed the robustness of explanatory variables in cross-country growth regressions by employing the Bayesian Averaging of Classical Estimates (BACE) approach, which constructs estimates as a weighted average of OLS estimates for every possible combination of the thirty-two included variables. However, their thirty-two variables were mostly selected from the less controversial variables in the literature, and therefore did not include investment.

4. Methodology

Unlike past studies that included several explanatory variables to estimate their impact on long term growth or investment), this study focuses on the controversial temporal causality between investment and growth by including only the robust explanatory variables of growth and investment in the system equations. The New Growth model is used with a Simultaneous Equations approach—two-stage least squares (2SLS). Other tests of causality could have been used (e.g., Granger causality in a Vector Autoregressive (VAR) framework); however the cross nature of this study advocates the use of a simultaneous equations approach because it would benefit from richer information while at the same time not compromising any serious econometric problems. The system-equation model takes the following form:

$$\text{Log } G_{ip} = \alpha + \chi I_{ip} + \eta \text{Log } GDPc_{it} + \theta \text{Life}_{it} + \mu \text{G exp}_{ip} + \phi \text{Openness}_{ip} \quad (1)$$

$$I_{ip} = \beta + \lambda \text{Log } G_{ip} + \phi \text{Openness}_{ip} + \pi (I\text{-Risk})_{ip} \quad (2)$$

where G represents economic growth, represented by the growth rate of real GDP per capita; and I is the total investment share of GDP. Trade openness is a measure of the total trade as a share of real GDP. The variable Risk uses the composite risk index of economic, financial and political as its proxy, which is borrowed from the International Country Risk Guide (various years). α and β are the estimated coefficients of the constant terms of equations (1) and (2). χ , η , θ , μ , λ , ϕ , and π are the estimated coefficient terms of investment, log income per capita, life expectancy, government expenditures, growth, trade openness and risk, respectively.

Subscripts tp and $t1$ represent, respectively, the (steady-state level) periodic average between 1982-1997, and the initial level for year 1982. Data are from the World Development Indicators, the International Financial Statistical Yearbook (selected years), and Summers and Hestons (1991). The initial level (1982) is used to reflect the lag nature of variables such as per capita income and life expectancy, while the steady-state level (periodic average of 1982-1997) is used to identify the long-term nature of variables such as investment, growth rate, government expenditures, and risk (Barro, 1997). Data on education is not included in the growth equation because it is problematic and lacks standardization in cross-country studies, especially when it comes to the quality of education.

This cross-country study encompasses eighty developing countries randomly selected from four regions and employs data for these countries for the average period 1982-97. The sampling technique uses a stratified sampling from four major geographic regions: South America, North America, Europe, and Asia. Africa and the Middle East are omitted for data availability and convenience where, for instance, life expectancy data is missing for various years and countries from the two excluded regions. This study argues in favor of one-way impact from investment to growth. It suggests that investment is an instrumental variable for growth. In other words, this study hypothesized that freer trade opens market for foreign competition, hence spurring investment, which in turn stimulates growth. Consequently, the two endogenous variables—investment and growth—play an instrumental role in identifying the impact of explanatory variables in each equation.

It is expected that the initial log of income per capita is negatively associated with growth reflecting the convergence property of the neoclassical theory. Life expectancy, an integral element of human capital, is represented by the average number of years to live, and is expected to be positively associated with the steady-state growth per capita, *ceteris paribus*. This variable reflects a more productive health and longer work life of the labor force. The variable “total government expenditures” as a share of GDP is expected to correlate negatively with growth. Large public (non-capital) spending is perceived as a measure of the intrusion of big government bureaucracy into markets, resulting in reduced efficiency and market distortions, hindering economic growth.

Trade openness, as measured by total trade as a share of GDP, is expected to boost investment due to the elimination (reduction) of tariffs and non-tariff barriers and the opening of markets. This mechanism would attract foreign direct investment (FDI) as well as stimulate domestic and private investments. However, recent standard literature argues that trade openness is positively and directly associated with economic growth (Dollar and Kraay, 2001). In addition, the composite index of economic, financial and political risk from the International Country Risk Guide (various years) is employed to proxy the level of investment risk. Risk enters the investment model and is hypothesized as inversely related with investment. According to standard finance theory, this expected negative relation indicates that investors are less attracted to risky markets unless risk premium exceeds a certain threshold.

5. Empirical Analysis

This paper employs a Simultaneous Equations system of the New Growth model by endogenizing growth and investment measures to test their temporal causality. Table 1 offers the descriptive results of all explanatory and dependent variables. The number of observations is eighty developing countries for the period 1982-97 averaged in one period (steady-state level) or just for 1982 (initial level). The descriptive statistics offer the dispersions (standard deviation), the averages (mean), and the minimum/maximum values of each of the cited variables.

The cross nature of this study raises suspicion of heteroskedasticity in the error term that could cause econometric problems by overestimating the estimated coefficients. Subsequently, the problem of heteroskedasticity is addressed following the White's (1980) procedure, which gives robust- heteroskedasticity estimates for the variance-covariance matrix of the estimated regression coefficients. Further, the multicollinearity test (by measuring the correlation among all pairs of independent variables) shows no serious signs of multicollinearity ($R < .6$), which may result in a specification error in the model.

The first model (Table 2) estimates a statistically significant impact of investment on economic growth, and shows that a one percent increase in investment as share of GDP is associated with approximately .04 percent increase in the economic growth rate per capita. Interestingly, once investment enters the regression, trade openness

appears to have an insignificant “direct” impact on growth. Furthermore, the growth regression model indicates that the initial income per capita is highly significant and inversely related to the growth rate. This supports the *convergence hypothesis* of the neoclassical theory, where poorer countries grow faster than richer ones, holding everything else constant. The estimated coefficient of life expectancy is positive and statistically significant at the 99 percent level of confidence. Alternatively, the variable “government expenditures” is negative, as hypothesized, but it is statistically insignificant.

Table 3 describes the investment model used to estimate the impact of growth on investment. Results reveal that growth has no significant impact on investment, while trade openness is highly significant, indicating that a one percent increase in trade openness-to-GDP ratio tend to spur investment by .07 percent. This implies that trade openness may significantly affect the instrumental variable “investment”, and in its turn, investment spurs growth. Finally, the combination of economic, financial and political risk is found to have a statistically significant negative effect on the growth rate per capita. Note that the risk composite index uses a scale between 0 and 100 where the higher the number the *less* risky is a country. Thus, a one point increase on the risk index (more stability) leads to a .1 percent increase in the investment-to-GDP ratio.

Table 1
Descriptive Statistics of All Explanatory and Dependent Variables

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Growth Rate	80	-1.61	4.19	2.199	.863
Investment	80	12.5	46.7	23.16	6.779
G Exp	80	8.23	58.77	30.53	12.79
Log GDPc _{t1}	80	-.79	3.24	1.516	1.131
Life _{t1}	80	53	78	71.46	5.265
Openness	80	14.64	316.34	60.093	62.404
(1-Risk)	80	41.77	89.55	70.86	12.202
Valid N	80				

Table 2
Growth Regression Results Using Simultaneous Equations. Testing the Impact of Investment on Growth

Variable	Coefficient	p-values
Constant	-6.624**	.022
Investment	.039**	.045
Log GDPc _{t1}	-.372**	.042
Life _{t1}	.122***	.004
G Exp	-.008	.309
Openness	.01	.22
R-square	.124	
F-value	5.657	
p-value of F	.009	
N	80	

Note: p-values: * < 0.1; ** < 0.05; *** < 0.01; The dependent variable is Growth. The two endogenous variables are Growth and Investment.

Table 3
Investment Regression Results Using Simultaneous Equations. Testing the Impact of Growth on Investment

Variable	Coefficient	p-values
Constant	24.743***	.000
Growth	.798	.727
Openness	.072***	.000
(1-Risk)	-.108**	.038
R-square	.434	
F-value	19.471	
p-value of F	.000	
N	80	

Note: p-values: * < 0.1; ** < 0.05; *** < 0.01; The dependent variable is Investment. The two endogenous variables are Growth and Investment.

6. Conclusions, Policy Implications, and Future Research

Despite the extensive empirical research on the determinants of economic growth, no attempt has been made to identify the direction of causality between investment and growth in developing economies and within the New Growth framework. Subsequently, this paper uses a Simultaneous Equation approach within the New Growth framework in an attempt to shed light on the causality between investment and economic growth as measured by changes in GDP per capita across countries. A random sample of eighty developing countries for the average period 1982-97 is used to test this relationship.

Findings reveal the following: (1) investment precedes and positively impacts growth, (2) contrary to the mainstream view, growth seems to have no significant impact on investment, (3) unlike much of the literature that argues in favor of a “direct” trade-growth nexus, findings show that trade openness stimulates investment, which in turn spurs growth, (4) the initial level of income per capita appears to have a negative relationship with growth rate per capita, thus supporting the *convergence hypothesis* of the neoclassical growth theory, and (4) life expectancy has a significant positive link with growth, which is consistent with the neoclassical growth literature.

Trade openness appears to strongly spur investment, while an increase in the combination of economic, financial and political risk retards investment and hence growth. Thus, freer trade and less risky markets seem to induce economic growth via the instrumental variable “investment”.

From a policy perspective, this study indicates that international investors may want to identify less risky international markets that are in the process of liberalizing their domestic economies and trade policies. Perhaps these investors and/or multinational corporations may even reap greater returns by investing in several developing economies that are still in the starting phases of implementing local economic reforms and stabilizing their economies. Thus, offering higher returns for these investors at “potentially” lower risk due to lower default and exchange rate risks.

It is also plausible that governments of developing countries may find it successful to attract foreign investments after they embark on liberalization reforms. They should also work on promoting more stable business environments through perhaps adopting sound macroeconomic, financial and political policies. For instance, sound macroeconomic policies could be the result of less volatile inflation, non-erratic monetary policy, and no chronic deficits. Few examples of less risky financial policies could partly represent avoiding currency devaluation, implementing sound banking and accounting systems, and avoiding reliance on short term foreign capital flows. And finally, some good examples of more stable political regimes could manifest by following the rule of law, adopting

intellectual property rights, punishing corruption swiftly, and promoting civil liberties and social freedom. Although these aforementioned policy examples are not addressed in this paper (within the investment--growth nexus), nevertheless they are worthy topics for future research.

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7. References

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Notes